

Designing an IoT Gateway



Dr. Cuno Pfister

Oberon microsystems, Inc.

pfister@oberon.ch, [@gsiot](#), www.limmat.co/blog

Oberon microsystems

Engineering services

In the area today called the **Internet of Things**

In recent years, several customer projects using
Bluetooth Smart (aka Bluetooth Low Energy, BLE)



Bluetooth Smart and IoT?

No relation

Bluetooth Smart is a local technology

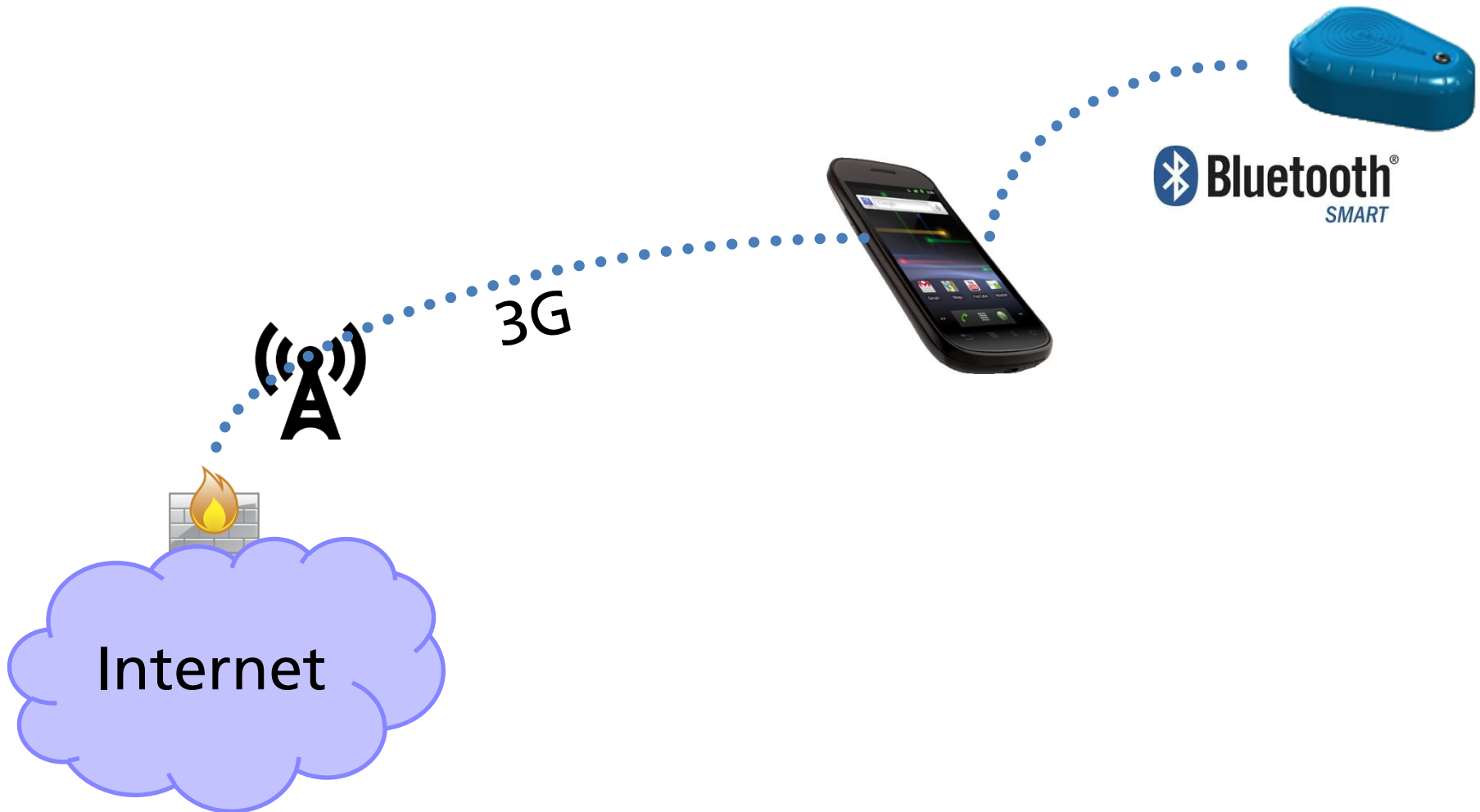
While IoT is about, well, the global Internet...

Implying the use of IP protocols

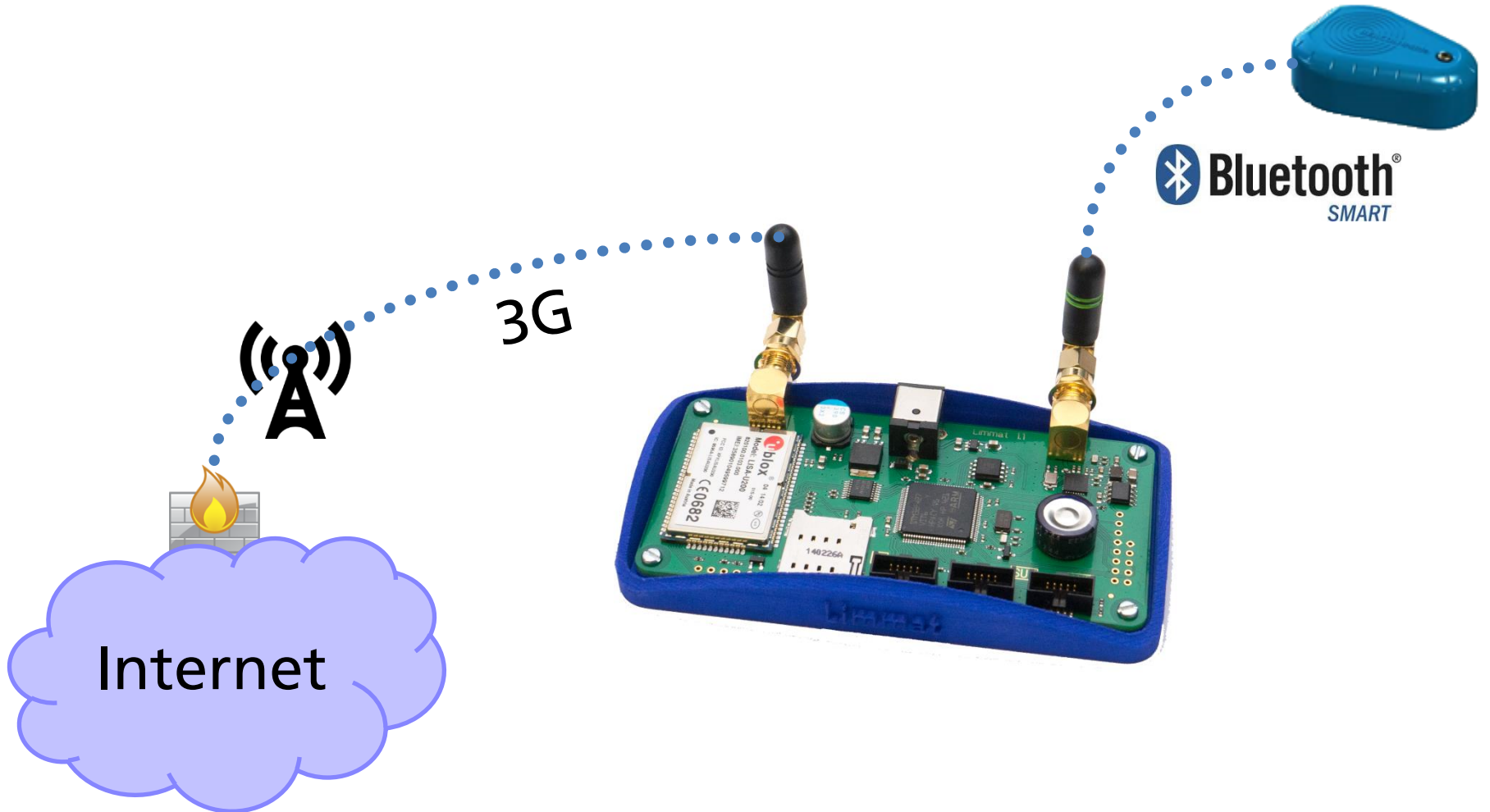
**To bring these technologies together,
we need gateways**

Use BLE as an edge technology for the IoT

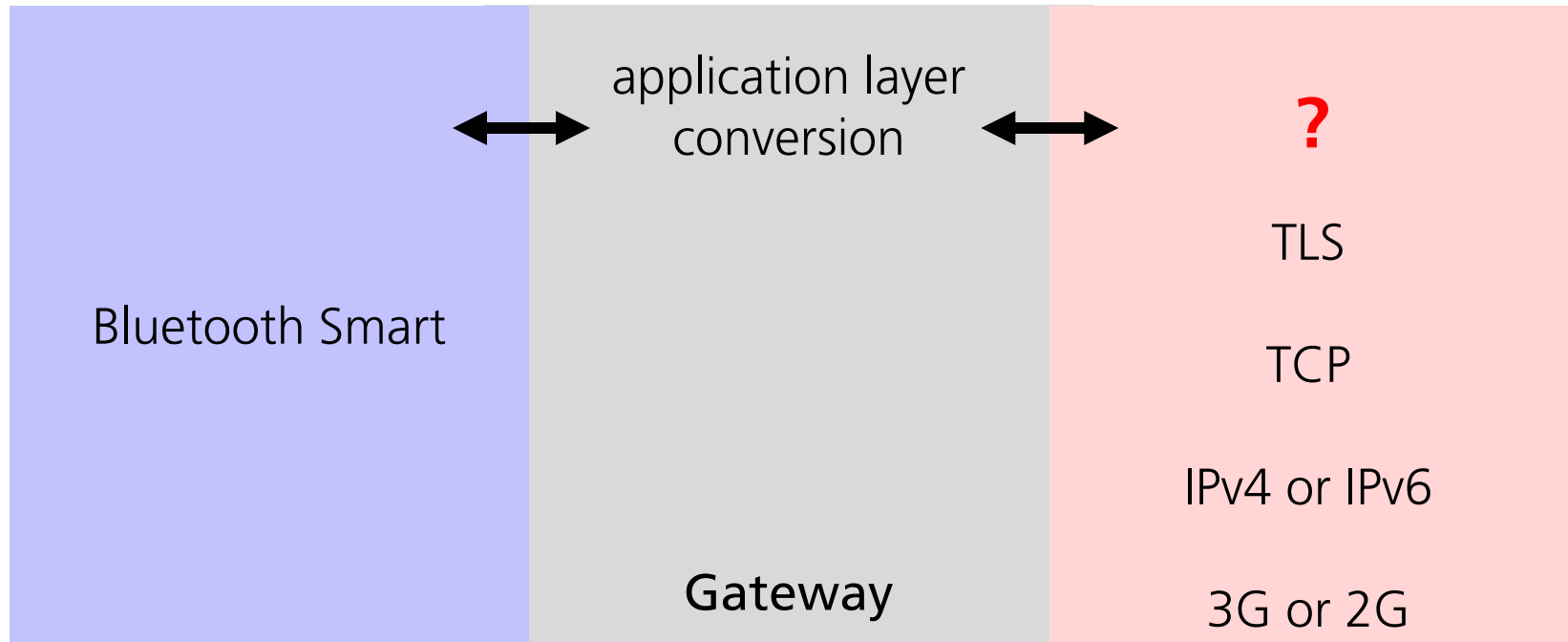
Ad-hoc 3G – BLE Gateways



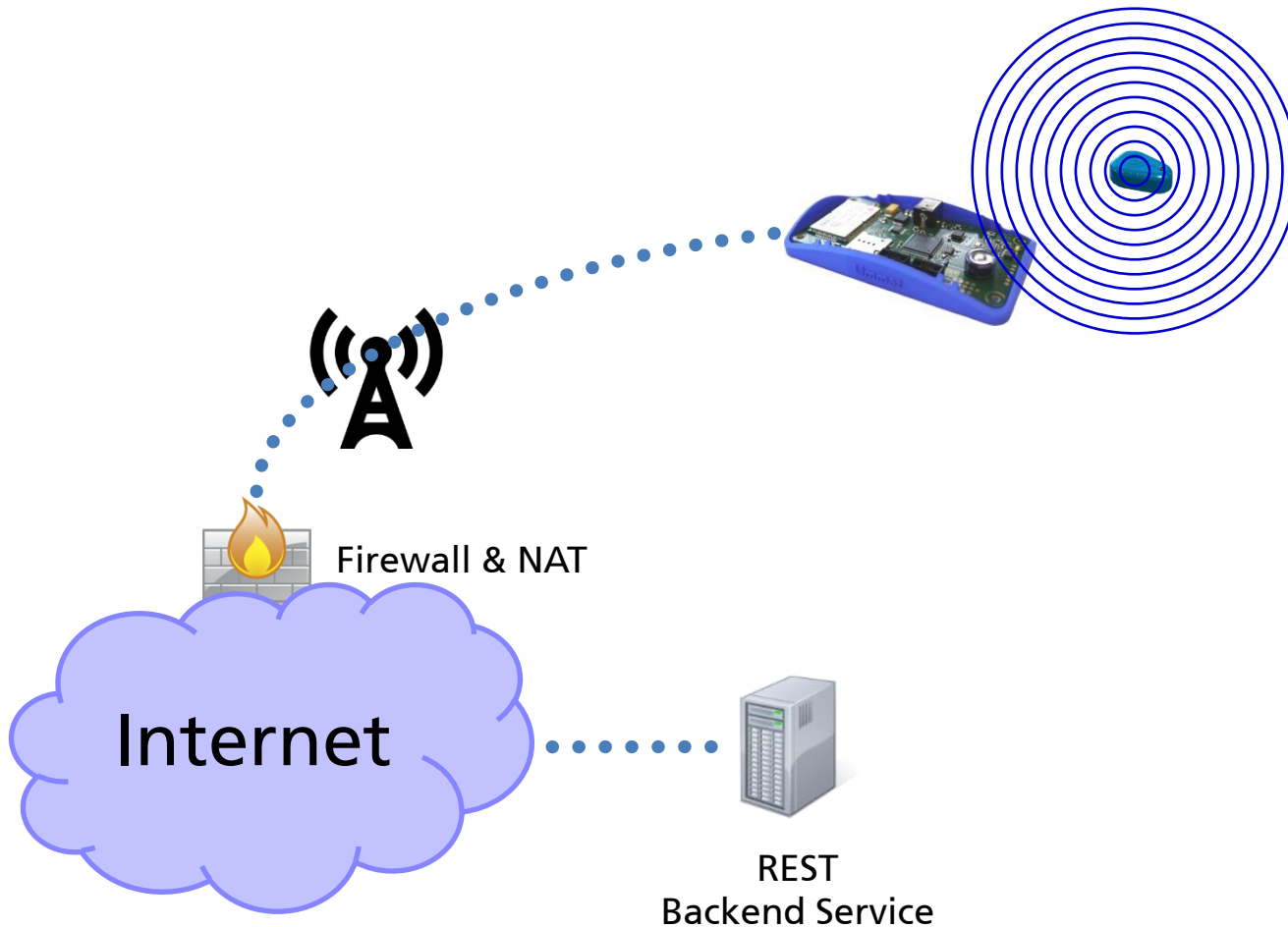
Limmat Gateway



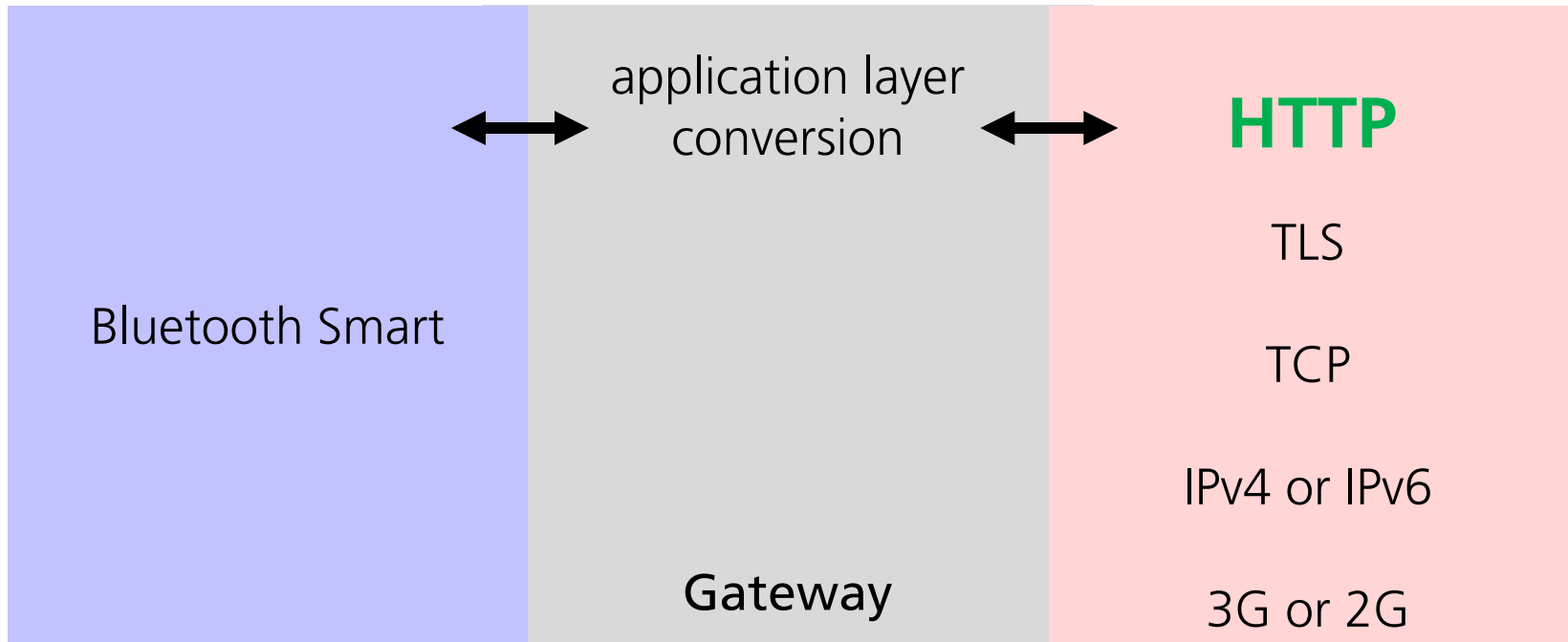
Protocol Conversion



Typical Scenario



HTTP



HTTP-Based Protocols

Limmat Beacon API

Gateway is HTTP client

Push events to a Web service using Webhooks

Advantage: no embedded know-how needed

GATT REST API (Bluetooth SIG standard)

Gateway is HTTP server

JSON-based format for read, write and notification messages

Access across Firewalls & NATs



Gateway



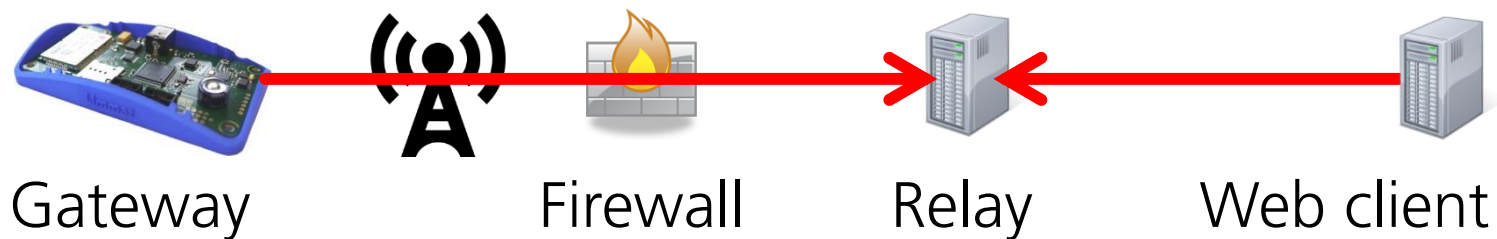
Firewall



Web client

Incoming connection is not possible
without special contracts with mobile operators

Relay Service with Reverse HTTP



Outgoing connection is possible

Some Security Tactics

«Service-assisted communication»

See blog post of Clemens Vasters

No shared secrets in gateways

Breaking one gateway would not affect others

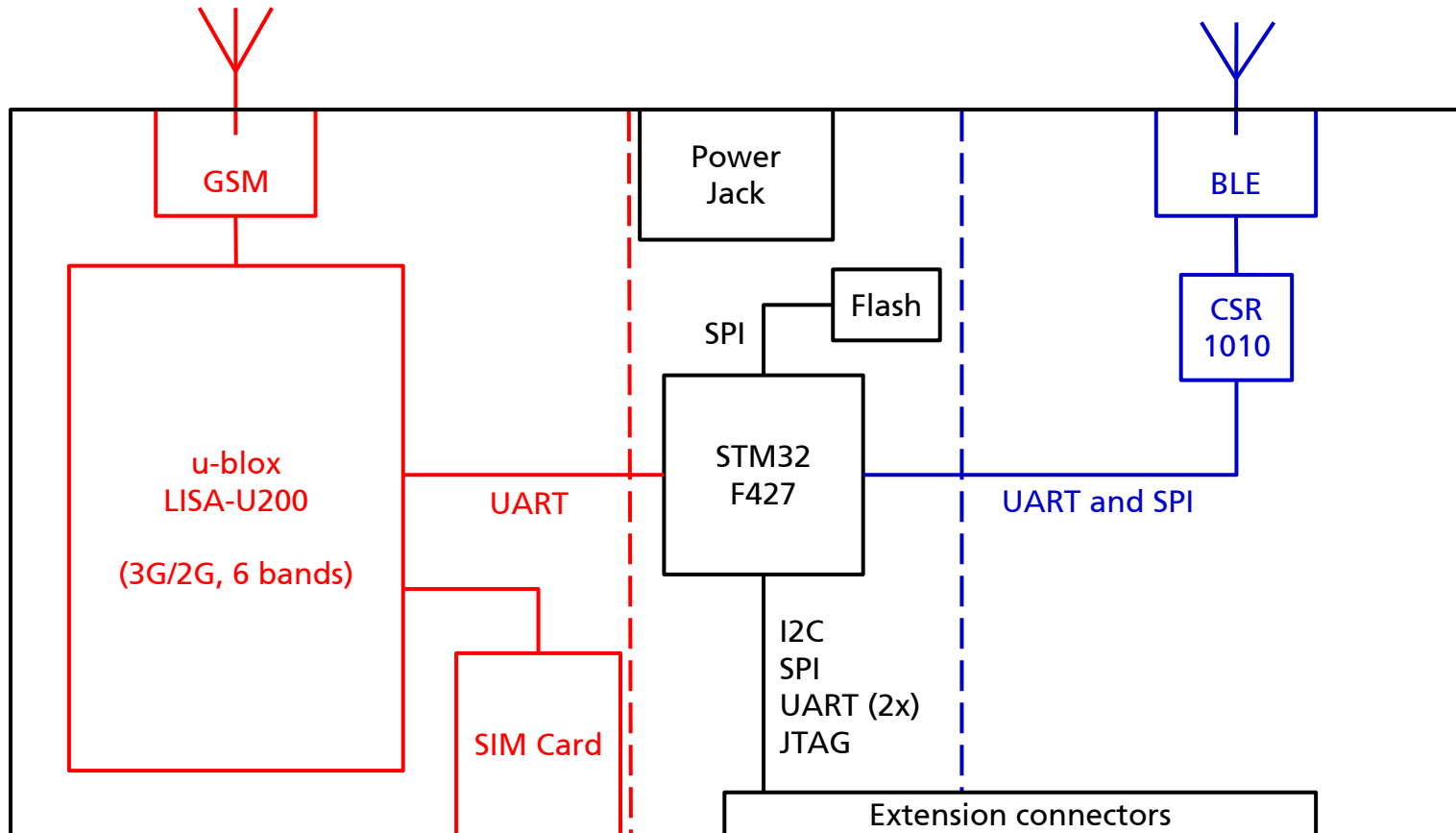
Good embedded TLS stack

embed TLS (formerly PolarSSL)

Keep attack surface small

Going «below Linux» is possible here

Reference Board



Cortex-M4 Microcontroller

STMicroelectronics STM32F427

168 MHz – 2 MB Flash – 256 KB RAM

Between STM32L0 and new STM32F7

Embedded guy

«This is a monster!»



IT guy

«Are you serious?
KB, not MB?»



Towards a Web of Things

Integration across silos as vision

Make it easy to integrate edge devices into the «Web of Things»

HTTP has been hugely successful

Proved to be scalable beyond all expectations

Seems like a «minimal viable protocol» on top of the IoT as well, for many kinds of applications

But what if we need more than «minimal viable»?

Some of the Challengers

MQTT	Message Queue Telemetry Transport
AMQP	Advanced Message Queuing Protocol
XMPP	Extensible Messaging and Presence Protocol
DDS	Data Distribution Service
OPC UA	OPC Unified Architecture
HAP	HomeKit Accessory Protocol
CoAP	Constrained Application Protocol

HTTP/2

Optimized encoding of headers

Multiplexing

Only requires one physical TCP connection

Lossless translation from HTTP/1.1

We use our relay service as
proxy (outgoing) & reverse proxy (incoming)

Small minimum feature set

Supported by Google, Microsoft, etc.

Limmat

A platform for creating Web of Things gateways

HTTP/2

Service-assisted communication

Edge processing supported

Bluetooth Smart Specifications

<https://developer.bluetooth.org/gatt/Pages/default.aspx>

https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=285910

https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=285911

Beacons

<https://developer.apple.com/ibeacon/Getting-Started-with-iBeacon.pdf>

<https://github.com/google/uribeacon>

HTTP/2

<https://github.com/http2/http2-spec>

<https://github.com/http2/http2-spec/wiki/Implementations>

Service-assisted communication

<http://blogs.msdn.com/b/clemensv/archive/2014/02/10/service-assisted-communication-for-connected-devices.aspx>

<http://www.yaler.net>

Limmat

<http://www.limmat.co/blog>